most intimate friends would believe it, and to many the matter is still an enigma. He seemed too great a philosopher to countenance such an act. It is not improbable that temporary insanity shattered his mind. No expert opinion has been published. Although the fact was seldom noticeable, the great chemist was a very nervous man and had for an extended period been under medical treatment, but without great avail. During the previous winter he was forced to reduce the number of his lectures, but he persisted to the last in assuming all the responsibilities that fall upon a director of so large an institution. The strain was too great. For the last four days he was unable to sleep at all, and the man whose face was still as quiet and pleasant as ever was probably distracted by the fear that the physical forces which had served him so well were threatened with destruction. Only those who have suffered as he did can rightly judge the man. Certain it is that the annoying rumors, circulated by irresponsible reporters, are without any foundation. Of the two letters found on his desk, one expressed his love for his family in most endearing terms. The other was a farewell to his close friend, Kuehne, the famous physiologist.

On account of his expressed wish and because the semester had closed, elaborate ceremonies were avoided. As the quiet assemblage, including many famous scholars, stood around the grave, wreath after wreath was laid at its head. The venerable Bunsen, to whom Victor Meyer went at the age of sixteen to learn chemistry, sent a laurel from his home near by. Adolph von Baeyer came from Munich with a wreath 'to his best friend.' The German Chemical Society paid a tribute to its lost President, and the grand-ducal family of Baden sent a token. Among the many other wreaths was one bearing the words, 'Dem grossen Lehrer in Dankbarkeit, Seine Amerikanischen Schüler.' Heidelberg suffers a great loss, not only as a university, but as a city, for Victor Meyer was a citizen, as well as a scientist, and, while he was profoundly versed in every department of chemistry, he found time to encourage the development of the fine arts.

It is fortunate that there remain such splendid representatives of his school as those who have been his assistant professors. The vacant chair may not be filled for some months. Temporarily the direction of the laboratory is in the hands of Professor Gattermann, who is pushing so rapidly to the front of his science. The other professors, Jannasch, Auwers, Goldschmidt and Knoevenagel are all well-known investigators, and have their own large circles of admiring students.

H. C. Cooper.

Heidelberg, August 15, 1897.

THE ANTHROPOLOGICAL SESSION AT TORONTO.

It may be worth a few lines in Science to say a word in correction of the many erroneous and even ludicrous newspaper reports of the above meeting which suggest to the memory the famous definition of the crab by the French Academy before it was criticised by Cuvier.

The paleolithic or neolithic age of the New London stone axe was not a subject of discussion, as reported, simply because there was no room for two opinions on the matter. It is beyond all question neolithic, as every archæologist would be ready to assert at a glance.

Nor was any attempt made to prove that American man was older than European man, because again the evidence is so far absolutely conclusive on the other side. The paleoliths of Europe antedate all relics yet known from this continent.

Nor, thirdly, was any attempt made to prove the existence of preglacial man in America. The speakers who claimed the greatest antiquity advocated nothing more than a late glacial date for the oldest traces of human handiwork in this country.

As these three points formed the chief part of many of the reports of the meeting, it is easy to see how far short they fell of correctly representing the speakers.

E. W. Claypole.

SCIENTIFIC LITERATURE.

THE GENESIS OF THE DIAMOND.

There has recently been published a volume of small size, but of especial interest and importance, in regard to the origin of diamonds.

This is none other than the posthumous issue of the full papers of the late Professor H. Carvill Lewis, edited by his friend, Professor T. G. Bonney, of London.*

It will be remembered that Professor Lewis was the first to present a clear and definite theory of the origin of the South African diamonds, as resulting from the intrusion of igneous rocks into and through carbonaceous shales, and the crystallization of the carbon throughout the rock as it cooled, from hydrocarbons distilled from the shale that had been broken through. These views, now for the most part accepted, and subsequently confirmed by other and very interesting parallel discoveries, he presented in two papers read before the British Association for the Advancement of Science at its meetings held in 1886, at Birmingham, and in 1887, at Manchester. Before he was able, however, to prepare them for publication and carry them to the greater completeness that he desired, Professor Lewis succumbed to an attack of typhoid fever, which removed one of the most brilliant and capable of the rising scientists of this country. Agreeably to his expressed wishes, his material was entrusted to his friend and co-laborer, Professor George H. Williams, of Johns Hopkins University; but, by a strange fatality, before the latter had time to arrange and edit these papers this distinguished scientist also fell a victim to the same disease, in 1894. The work was then committed to Professor Bonney and is at last given to the scientific world.

The book consists of an introductory note by Mrs. Lewis; a preface by Professor Bonney; the two papers of Professor Lewis himself, with some later notices and references by the editor; a brief account of similar material from other localities, belonging to Professor Lewis—also by the editor; a closing note on some other MSS. of Professor Lewis, and a full index. There are also two plates and a number of smaller illustrations, the latter from Professor Lewis' own drawings.

*Papers and notes on the 'Genesis and Matrix of the Diamond.' By the late Henry Carvill Lewis, M.A., F.G.S., Professor of Mineralogy in the Academy of Natural Sciences, Philadelphia, Professor of Geology in Haverford College, U. S. A. Pages xvi+72. 2 Plates. Edited from his unpublished MSS., by Professor T. G. Bonney, D.Sc. LL.D., F.R.S., &c. Longmans, Green & Co., London and Bombay. 1897.

The first paper, 'On a diamond-bearing peridotite and on the history of the diamond' (1886), is brief, dealing with the general character and occurrence of the diamantiferous rock at Kimberley, and outlining Professor Lewis' theory.

The second paper, 'The matrix of the diamond' (1887), is more extended and goes into an exhaustive discussion and comparison of the various aspects, contents and alterations of the rock, which he finds to be different from any previously described, and, therefore, proposes for it the name of Kimberlite. Its main character is that of a highly basic porphyritic peridotite, filled with olivine crystals and grains, more or less altered, and various other minerals—serpentine, tremolite, etc., with bronzite, rutile, perovskite, pyrope garnets, micaceous minerals and other forms, and at times brecciated in structure, filled with fragments of carbonaceous shale brought up from below. The shales are of Triassic age, the 'Karoo beds' of that region, and the intrusion of the peridotite in the great 'pipes' or chimneys that constitute the mines is therefore proved to be of a later, though not exactly determined period.

The question has sometimes been raised whether the diamonds themselves may not have been carried up from a deeper source in rocks below, instead of originating in the peridotite; and the occurrence of broken crystals has been cited in support of this view. Professor Lewis, however, disposes very completely of this idea in two ways: He refers to the well-known fact that each of the great mines or 'pipes' yields diamonds that have, in some respects, a type of character peculiar to that one and different from the others, so that African experts, and even those who have never been there, can recognize from which mine any diamond has come. Further, as to the broken crystals, he shows that breakage not unfrequently occurs after the diamonds are removed from the rock, and points out that this is a result of strain in their formation, as indicated by microscopical and optical examination, and that such a condition is known to produce ruptures and explosions in other minerals. It may be added here, although Professor Lewis does not speak of it, that many crystals must be broken in the blasting of the rock, the shoveling and the carting of the loosened material, and the various mechanical processes employed at the mines, and that pieces of such broken crystals would be separated and scattered to various parts of the immense dumping and weathering floors, never to be recognized as fragments of the same one when finally recovered, perhaps at very different times.

The rock itself is a dark green, compact material, resembling serpentine and containing a large proportion of olivine, in grains and crystals; several green minerals that are not conspicuous, from the resemblance of their color to the ground-mass (enstatite, chrome-diopside, smaragdite and bastite); a mica, probably biotite, more conspicuous and quite abundant, and frequent grains of pyrope garnet, sometimes of gem quality and great beauty, and miscalled 'Cape Rubies.' Of smaller disseminated minerals are to be noted perovskite, quite frequent, and magnetite, chromite, ilmenite and picotite, less so, though common. Rare and minute occurrences are apatite, epidote, orthite, tremolite, tourmaline, rutile, sphene, leucoxene. As decomposition products there are serpentine and calcite, abundant, and zeolites, chalcedony and talc; also cyanite (?) These, with diamonds and included fragments of carbonaceous shale, make up the contents of this remarkable rock.

Professor Lewis then goes into a detailed account of the mode of occurrence of these minerals, beginning with the most conspicuous species—the olivine—which is remarkable for its fine cleavage-surfaces and very interesting in its alterations. These are chiefly (1) into serpentine, proceeding from without inward, and penetrating along crevices and fractures, also sometimes in the form of chrysotile, producing a velvety border or coating to the grain; (2) tremolite, more internal, the fibrous structure developing parallel to the vertical axis and domes of the olivine crystals; (3) when both these alterations are present and have gone so far as to obliterate most or all of the olivine, a talc-like substance intervenes between them in which are developed minute needles of rutile, arranged parallel to the faces of the olivine crystal. The rock contains every stage of these changes from pure bright unaltered olivine to those forms that have borders of serpentine or chrysotile, or incipient tremolite fibers within, to the complete alteration just described. The relation of all these to similar phenomena in other rocks, and in meteorites, is discussed with much fulness.

Professor Lewis then takes up the smaragdite, chrome-diopside, bastite and enstatite (or bronzite, for it is just on the line between the two varieties). The two first named are, in some cases, fine enough in color and clearness to yield gems, and also sometimes the bronzite; all are colored by chromium. The diopside occasionally gives rise to calcite by alteration.

The mica is next considered; as all who are familiar with the rock are aware, it is the most prominent of the contained minerals to the eye. It is somewhat anomalous in character, being chemically a biotite, but optically nearer to phlogopite. It occurs in several distinct ways: (1) as included crystalline masses or plates, apparently an original ingredient of the rock; (2) surrounding grains of pyrope; (3) rarely, as a result of the alteration of enstatite; and (4) as a metamorphic product from the included fragments of shale; and the first form has produced, by hydration, the vermiculite variety called vaalite, which occurs freely in the decomposed peridotite so largely known as the 'blue-ground.'

After referring to the pyrope garnets, and suggesting that the various garnetiferous serpentines are doubtless derived from the decomposition of similar peridotites, as further indicated by their likewise containing olivine, bronzite, chrome-diopside, etc., he mentions another variety of garnets as found in this rock, very small, very brilliant, very hard, colorless or greenish, and extremely difficult to distinguish from small diamonds. These Professor Lewis is inclined to refer to demantoid. (?)

An interesting part of this discussion next follows, in relation to the perovskite, which is pretty abundant in small crystals, of cubical habit. Professor Lewis gives much attention, and a number of drawings, to the optical features of this species, and strongly inclines to the view that regards perovskite as a highly twinned orthorhombic mineral and not isometric save in external aspect. This has long been a mooted point, and these observations are an important contribution. Of much interest also are the chemical and genetic relations of this species as here presented; the crystals often enclose grains of what Professor Lewis terms a titanic spinellid, perhaps a titaniferous magnetite, perhaps ilmenite, indicating a derivation therefrom; they also, in some cases, lie in a curious manner, upon or around partially altered olivine crystals. The remark is made that, while perovskite is familiar in various non-feldspathic igneous rocks, it has not been found in peridotite until Professor Williams recognized it in the peculiar rock from Syracuse, N. Y., and that later Professor Lewis identified it in the similar rock from Isom's Creek, Kentucky, where it had been previously regarded as anatase. These three rocks, those just named and the African, are the only known occurrences of what is here named Kimberlite. The article goes on to show that in basic eruptive rocks the titanium takes the form of perovskite, while in acid rocks it forms sphene; in intermediate ones it develops ilmenite or titanic iron; and these deductions harmonize precisely with important experiments of Bourgeois, in the artificial production of titanium minerals.

After going into some particulars as to the minor minerals found in this rock, Professor Lewis then takes up the base or ground mass and discusses it minutely. He terms it 'a more or less homogeneous serpentinous mass,' very difficult to study by reason of its decomposed condition, consisting now of a mixture of serpentine with calcite and some other products of alteration, the original structure being wholly lost.

Fragmental enclosures are frequent, 'both of the adjoining shale and diabase, and also of more deeply seated granite, gneiss, eclogite, and other related rocks.' Of these the shale predominates, sometimes making the rock a breccia. The shale itself is highly charged with carbon, so as to be quite combustible; but the included fragments are altered, having lost their carbon and become harder, sometimes even metamorphosed to a micaceous structure, as before referred to. In size they vary from large masses, in the upper part of the mines, called by the workers 'floating-reef,' to small fragments, diminishing in number and size in descending.

Professor Lewis goes into very detailed petrographical and chemical discussion as to the original character of the rock, in which it is hardly possible to follow him in a review, and finding no known rock that presents identical characters, he proposes for it the name of Kimberlite. This he designates as 'a porphyritic volcanic peridotite of basaltic structure,' and notes three forms of its occurrence: (1) Kimberlite proper, a typical porphyritic lava; (2) Kimberlite breccia, the same rock broken and crushed by volcanic movements and crowded with included fragments of shale; (3) Kimberlite tuff, the fragmental and tufaceous portion of the same rock. These varieties graduate into each other, and all occur together in the same neck or crater, the second, however, being most abundant and most productive of diamonds.

He treats of the origin of the brecciated structure, which has caused much discussion, some geologists regarding the whole rock as a sort of tufa or volcanic mud, while others hold that it is a true outpouring lava that has carried up fragments of the rocks broken through it its course, and has since been largely decomposed. Professor Lewis urges the latter theory strongly, and supports it by many arguments; while the editor, Professor Bonney, evidently inclines to the other view, advocated by Professor W. H. Hudleston, in 1885, and by some others. There is not space here to review Professor Lewis' several arguments for the true igneous character of the Kimberlite and against the tufaceous theory. The one to which Professor Bonney accords the chief importance is the identity of the rock with that from Syracuse, New York, and Elliott county, Kentucky, where it occurs in actual dikes, such as are not found in tufas. The brecciated character, which is so marked, is referred by Professor Lewis to three causes, acting either separately or perhaps together. These are (1) rapid cooling and shrinkage; (2) 'friction brecciation,' from contact with the wall-rock; and (3) subsequent movements and explosions in the crater itself, below. He illustrates and parallels the first of these from meteorites, to some of which this rock bears marked resemblance both in structure and contents, and the others from well-known occurrences in terrestrial volcanic rocks.

The third section of the volume is occupied with a detailed account, from specimens and notes of Professor Lewis, of the two other known occurrences of Kimberlite, at Syracuse, N. Y., and Willard, Ky. The identity of these with the African rock, in almost all particulars, is remarkable, and as they form définite eruptive dikes, Professor Lewis' view as to the latter is strongly confirmed.

It remains only to call attention to other and later facts which tend to bear out the views presented in this remarkable posthumous article.

The presence of a residual hydrocarbon in the rock of the African diamond mines was shown by an interesting and important observation of Sir Henry E. Roscoe (Proc. Lit. and Phil. Soc. of Manchester, XXIV., 1885, p. 5), which is alluded to by Professor Lewis in his second paper, and has frequently been cited in discussions of the subject. He found that the 'blue-ground' on treatment with hot water yielded an aromatic hydrocarbon, which he was able to separate by digesting the 'blue-ground' with ether and evaporating the solution. It then appeared as a crystalline aromatic solid, burning with a smoky flame (showing it rich in carbon), volatile, and melting at 50° C.

The bearing of this fact upon Professor Lewis' theory is clear. It indicates that the igneous rock, breaking through the highly carbonaceous Karoo shales (37.50 p. c. of carbon; Whitfield, U. S. Geological Survey; Gems and Prec. Stones North America, 1889, p. 33) became charged with volatilized hydrocarbons distilled from the shale, and that in cooling these had crystallized partly into diamonds and partly into the many carbonadoes, larger and smaller, which are distributed through the rock. Professor Roscoe's material strongly suggests this theory, which, indeed, he himself independently propounded.

In 1886 a meteorite fell at Novo Urei (September 22d) in the province of Pensa, Russia, which was found to contain about 1 per cent. of diamond carbon, in the form of gray particles.*

In 1887 Mr. Fletcher (*Mineralogical Magazine*, 7, 121) described the new mineral 'Cliftonite' —a black substance with a hardness of 2.5 and a density of 2.12, occurring in cubes with faces of the dodecahedron or tetrahexahedron in the meteorite of Youndegin, West Australia. This suggested a graphitic alteration of diamond—a view taken by Brezina (*Ann. Mus. Wien*, IV., 102, 1889) regarding this new species and certain graphitic crystals of cubic type, observed long before in the Arva meteorite and regarded as pseudomorphs after pyrite by Haidinger (Pogg., 67, 437, 1846), but later by Rose, as after diamond (*Beschr. Meteor.*, 40, 1864). Similar crystals were also known in the Sevier iron of Cocke county, Tenn.

In 1891 the discovery of diamond, or at least of diamond carbon, in some quantity in the meteoric iron of Cañon Diablo, Arizona, was announced by the late Professor A. E. Foote (*Amer. Jour. Science*, Vol. XLII., July, 1891, pp. 413–417) and Dr. George A. Koenig. In July, 1892 (SCIENCE, p. 15), Dr. O. W. Huntington gave further experiments on the same material, confirming the decisions of Professors Foote and Koenig; and in December of the same year similar results were published by M. C. Friedel (*Bulletin de la Soc. Francaise de Mineralogie*, No. 9, p. 258). A crucial test was then proposed by G. F. Kunz, of New York, and carried out in the presence of Dr. Huntington, at the World's Fair at Chicago, September 11, 1893, viz., the cutting of polished faces on pieces of diamond with some of the carbon powder from the cavities of the Cañon Diablo meteorite (*Amer. Jour. Sci.*, Vol. XLVI., December, 1893; and Min. Resources U. S., 1893, pp. 683–685).

In the meantime Professor Henri Moissan, of Paris, had been making his now celebrated experiments on the artificial production of diamonds from the cooling, under extreme pressure, of highly carbonated iron fused in a specially constructed electric furnace (Mineral Resources U. S., 1895, pp. 903–904).

All these facts taken together form a remarkable series of confirmatory evidence of the views advocated by our late countryman in re-

* Daubreé's discussion of the analogy of the occurrence of the diamond in the meteorites and in the South African Kimberlite was the next important paper on this subject. (Comptes Rendus, 110-18, 1890.)

gard to the production of this most precious of gems, the origin of which has been so obscure a problem in mineralogy and geology. Another point of great scientific interest developed in the course of these investigations is the close similarity, both in composition and in structure, existing between some of these rarer igneous rocks of our globe and the extra-terrestrial visitants that come to us from space.

Mr. G. F. Becker, in a recent letter, takes a different view of this subject and holds that I have misinterpreted Professor Lewis, and that he did not regard the diamonds as due to carbonaceous matter taken up from the shales. He claims that "Lewis over and over again says that the diamond is as much a part of the Kimberlite as its other component minerals." It is true that he did use such an expression of 'the Kimberley rock' (p. 44); but this is in summing up his argument that the diamonds are in their original matrix, as against the early notion of their having been washed into the 'kopjes' from above, or the later theories of their having been carried up with the igneous rock from some deeper source below. The statement relates merely to 'the matrix of the diamond'—the subject of the article—not to the source of the carbon. Moreover, diamonds are not present in the Kimberlite of Syracuse, N. Y., or of Elliott County, Kentucky,* which Professor Lewis recognized as the same rock. He says (p. 56): "In mineral composition, in eruptive character, in structure, in enclosures, the three rocks are identical." It is plain, therefore, that he did not regard diamonds as an essential ingredient of Kimberlite. As to their source being carbon derived from the shales, it is true that Professor Lewis does not in these papers distinctly so assert, though he refers frequently and pointedly to the association of diamonds with the penetrated and included shales. But in personal conversation, at a period between the dates of his two papers, and before he had even heard of the very suggestive experiment of Sir Henry Roscoe, Professor Lewis expressed to the writer his definite belief that such was their origin. The knowledge of this fact may have led me to state this view as held by Professor Lewis more clearly than appears on the face of his paper, and doubtless explains the perplexity that Mr. Becker expresses as to how he and I can read the article differently.

Mr. Becker says: "I consider the diamonds as much a part of the Kimberlite as zircons are a part of granites." This may be Mr. Becker's view; and he is a high authority, with whom I would not lightly disagree; but it can hardly be claimed as the view of Professor Lewis, when he asserts (as above noted) the absolute identity of the diamond-bearing Kimberlite of Africa with the non-diamond-bearing rocks of Syracuse and Kentucky. The question is not whether the diamonds (in Africa) are 'a part of the Kimberlite.' Undoubtedly they are so, there; but how came they to be so at that locality and not at the others? This subject was fully discussed by the writer in 'Gems and Precious Stones of North America,' pp. 32–34, in connection with the examinations made by Mr. Diller and myself in 1887, as to the possible occurrence of diamonds in Kentucky, as suggested by the similarity of the rock. It was there shown that, while the shales penetrated by the African Kimberlite had 37.50 per cent. of carbon, those traversed by the Kentucky Kimberlite contained but 0.68 per cent. The same rock breaks through a body of shale in two localities, the one rich in carbon, the other poor; the intruding rock is fitted with diamonds in the former case and none appear in the latter. And why did Lewis search everywhere for localities where serpentines and peridotites occurred associated with coal formations?

Professor Lewis observes (p. 8): "The rock (at Kimberley) appears in two types, one not bearing diamonds, the other diamantiferous, and the distinction between them is suggestive. Both occur in the same mine and are dark, compact, heavy rocks, closely resembling one another and differing mainly in the fact that one is free from enclosures of foreign substance, while the other is full of fragments of shale and other impurities. It is the latter which is diamantiferous." On p. 46 he notes the fact that the fragments of shale included in the igneous rock have lost their carbonaceous matter; and

* Is there a diamond field in Kentucky? J. S. Diller–G. F. Kunz, SCIENCE, Vol. X., 1887, pp. 140–142.

on p. 51 he cites as of great interest the observation and experiment of Professor Roscoe, elsewhere noted, as to the extraction of a hydrocarbon from the 'blue ground.' These references alone would indicate Professor Lewis' views, even apart from his own statement of them to the writer.

Mr. Becker also alludes to the broken crystals, as repeatedly seen by him in separate fragments enclosed or embedded in the rock, and as not being considered rarities at Kimberley. These occurrences, however, may well be due to the very causes treated of by Professor Lewis in explaining the brecciated character of the rock (p. 54 and above noted), especially the first and third, the latter in particular, 'subsequent explosions and movements in the crater' below. Any such action sufficient to break up the Kimberlite into the likeness of a breccia would easily shatter the highly cleavable diamond crystals and bring about the condition seen and described by Mr. Becker.

It may not be out of place here to recall an instance where, in another locality, the occurrence of diamond may be connected with a similar outbreak of igneous rock through beds containing carbon. In a paper, 'On Bohemian Garnets,' read by me before the American Institute of Mining Engineers, and published in their Transactions for February, 1892, mention was made of a diamond crystal found in 1870 at Dlaschkowitz, Bohemia, among a number of the pyrope garnets which are derived from the decomposition of peridotite rock. After being disputed and identified, it was deposited in the public museum at Prague, where I examined it, as well as the locality where it was found. The decomposed serpentinous rock has evidently been transported from the north (probably by glacial action) and there are found, at a distance of twenty or thirty miles in that direction, basaltic outflows that have broken through the coal measures. Here, again, is a suggestion of similar conditions, and the occurrence of this single crystal is not without interest in such a connection, as may be a Ural crystal at Chitanka, where I identified serpentine and pyrope, but not any carbonaceous materials, as my time was very limited.

It is a matter for national pride that this remarkable investigation should have been made by an American scientist; and a debt of gratitude is due both to the great English meteorologist—the editor, Professor Bonney—for his labor of love, alike to science and to a deceased friend, and also to Mrs. Lewis, who has so carefully sought to prepare and make public these papers of her brilliant and lamented husband.

GEORGE F. KUNZ.

NEW YORK.

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